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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Tolmie, et al
Appl. No.	:	Unknown
Filed	:	Herewith
For	:	OIL FROM WATER SEPARATOR
Examiner	:	Unknown

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to examination of the above-captioned application, please amend the application, based on the amendment from PCT, as follows:

IN THE SPECIFICATION:

Page 1, line 2, after the title, insert the heading: "Field of the Invention"

Page 2, line 19, delete "Brief Description" from the heading, and insert --Summary--.

Please add the following abstract:

Abstract

An oil from water separator has an oil disengagement chamber adapted to receive an oil and water mixture and retain it for a sufficient time in a relatively undisturbed state so that oil in the mixture floats to the top of the mixture. This results in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface of the mixture. The oil disengagement chamber is partially separated from an effluent water chamber by an under flow baffle which ducts said substantially oil free volume of water to the effluent water chamber. The oil disengagement chamber has a low liquid level which is higher than the under flow baffle. The outflow of the substantially oil free volume of water from the effluent

water chamber is limited to a rate of outflow which is a function of the head of the liquid in the effluent water chamber. The outflow is limited by a siphon which primes at a chamber high liquid level and loses prime at said chamber low liquid level, or by holes in a weir wall.

IN THE CLAIMS:

Please delete claims 1-32 in the original and amended claims in the PCT application, and insert the following new claims:

CLAIMS

33. An oil from water separator including an oil disengagement chamber adapted to receive an oil and water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof, said oil disengagement chamber partially separated from an effluent water chamber by an under flow baffle which ducts said substantially oil free volume of water to said effluent water chamber, the oil disengagement chamber having a low liquid level which is higher than the under flow baffle, the outflow of said substantially oil free volume of water from said effluent water chamber being limited by flow retarding means to a rate of outflow which is a function of the head of the liquid in said effluent water chamber.

34. The separator of Claim 33, wherein said flow retarding means is operable to accumulate said oil and water mixture in said oil disengagement chamber in an accumulation volume above the chamber low liquid level.

35. The separator of Claim 33, wherein said flow retarding means comprises at least one siphon which primes at a chamber high liquid level and loses prime at said chamber low liquid level.

36. The separator of Claim 33, wherein said flow retarding means comprises at least one bleed aperture.

37. The separator of Claim 36, wherein said at least one bleed aperture is located at the level of said chamber low liquid level.

38. The separator of Claim 33, wherein said flow retarding means is sized with reference to expected inflow of said oil and water mixture into said oil disengagement chamber such that, during operation, the level of said oil and water mixture will rise from said chamber low liquid

level and then return to said chamber low liquid level, thereby defining an oil and water mixture accumulation volume above said chamber low liquid level.

39. The separator of Claim 38, wherein said accumulation volume has a characteristic which is a function of

(a) inflow rate; and

(b) desired residence time of said oil and water mixture in said oil disengagement chamber.

40. An oil from water separation system including an oil disengagement chamber having a flush storage volume defined between a chamber high liquid level and a chamber low liquid level; said flush storage volume caused to exit from said chamber on attainment of said chamber high liquid level.

41. The system of Claim 40, wherein said flush storage volume is caused to exit by means of a siphon.

42. An oil from water separator including an oil disengagement chamber adapted to receive an oil and water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof, and means for retarding outflow from said chamber until said mixture reaches a predetermined chamber high liquid level whereupon said volume of water is caused to exit said chamber.

43. The separator of Claim 42, wherein, on reaching said chamber high liquid level, outflow is initiated and maintained until a predetermined chamber low liquid level in said chamber is reached at which time outflow is terminated.

44. The separator of Claim 43, wherein said means for retarding outflow is controlled by means sensitive to said chamber high liquid level and said chamber low liquid level.

45. The separator of Claim 42, wherein said outflow is drawn from a point at said predetermined low level in said mixture.

46. The separator of Claim 44, wherein said means sensitive to said chamber high liquid level and said chamber low liquid level is a siphon.

47. The separator of Claim 44, wherein said sensitive means is a level switch actuated pumping system.

48. The separator of Claim 42, wherein, on reaching said chamber high liquid level, outflow is initiated and maintained until a predetermined chamber low liquid level in said chamber is reached at which time outflow is terminated by said means for retarding outflow.

49. The separator of Claim 42, wherein said outflow is controlled by means sensitive to said chamber high liquid level and said chamber low liquid level.

50. The separator of Claim 48, wherein said outflow is drawn from a point at said predetermined low level in said mixture.

51. The separator of Claim 42, wherein said means for retarding outflow comprises a retention wall having at least one aperture at a predetermined level passing therethrough, said at least one aperture adapted to regulate flow of water from said disengagement chamber when said mixture reaches said predetermined chamber high liquid level.

52. An oil from water separator including an oil disengagement chamber adapted to receive an oil and water mixture and retain it for an extended time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof, outflow from said chamber being controlled in a predetermined way by flow retarding means.

53. An oil from water separator including an oil disengagement chamber adapted to receive an oil/water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof, wherein outflow from said chamber is limited by flow retarding means to a predetermined function of the level of said oil and water mixture in said chamber.

54. The separator of Claim 53, wherein said flow retarding means is operable only between a chamber low liquid level and a chamber high liquid level.

55. The separator of Claim 54, wherein said flow retarding means comprises at least one siphon which primes at said chamber high liquid level and loses prime at said chamber low liquid level.

56. The separator of Claim 53, wherein said flow retarding means comprises at least one bleed aperture.

57. The separator of Claim 56, wherein said at least one bleed aperture is located at the level of said chamber low liquid level.

58. The separator of Claim 53, wherein said flow retarding means is sized with reference to expected inflow of said oil and water mixture into said oil disengagement chamber such that, during operation, the level of said oil and water mixture will rise from said chamber low liquid level up to a higher liquid level and then return to said chamber low liquid level, thereby defining for each situation an oil and water mixture active lag capacity between said higher liquid level and said chamber high liquid level.

59. The separator of Claim 58, wherein said active lag capacity has a characteristic which is a function of:

(a) inflow rate; and

(b) desired residence time of said oil and water mixture in said oil disengagement chamber.

60. A method of conversion of a decant separator an oil from water separator which has an oil disengagement chamber adapted to receive an oil and water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof, the oil disengagement chamber being partially separated from an effluent water chamber by an under flow baffle which ducts the substantially oil free volume of water to the effluent water chamber, the oil disengagement chamber having a low liquid level which is higher than the under flow baffle, said method comprising the step of installing a flow retarding device in or in association with a weir wall of the decant separator so that a rate of outflow of the substantially oil free volume of water is controlled as a function of the head of the liquid in the effluent water chamber.

61. An oil from water separator system as defined in Claim 33, comprising a first and second oil from water separators each as defined by Claim 33, said plurality of separators connected in series whereby outflow from a first separator passes to an inlet of a second separator.

62. A separator of Claim 61, wherein decant overflow from said first separator passes to said inlet of said second separator.

Appl. No. : **Unknown**
Filed : **Herewith**

REMARKS

The foregoing amendments more closely conform the application to U. S. practice. The above requested changes to the application do not add new matter, and entry of the amendments is respectfully requested.

Respectfully submitted,

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OIL FROM WATER SEPARATOR

The present application relates to oil from water separators and, more particularly, such separators suitable for use in inground or aboveground installations where it is desired to prevent oil in water concentrations above a predetermined limit from being distributed to the environment in an uncontrolled fashion.

BACKGROUND

Mechanical oil from water separator systems are known. Devices/systems are also known that provide settling in chambers separated by baffles - refer the arrangement of Fig. 1 which shows a Prior Art American Petroleum Institute (API) oil from water separator design. It consists of a rectangular tank with two or more vertical partitions or baffles to separate entry chamber, oil disengagement chamber and effluent water chamber, and which is designed to run full of water.

The API oil from water separator is sized to provide low turbulence conditions and sufficient residence time for oil globules with a minimum diameter of 0.015 cm (150 microns) to separate from the oil/water mixture flowing though the separator.

This prior art system can be characterised as a decant-type system where for every input of liquid there is an output of a similar amount at the same time, thereby affecting separation efficiency.

Attempts have been made in the prior art to control the level of the oil/water interface, for example see US5147534 (Rymal) and US4031007 (Sierra) and, more generally, see US4960513 (Young), US4436630 (Anderson) and US5378353 (Koch).

In all of these systems, whilst there has been a move away from a simple decant-type approach, there is usually added a specific oil from water separation process beyond mere gravitational separation. Koch requires a specific separate coalescer unit whilst US 4554074 (Broughton) utilises separation plates.

In many applications it would be desirable to employ a separator system having the intrinsic simplicity of the API-type systems whilst achieving consistent predetermined levels of separation of oil from water.

It is an object of the present invention to provide an inherently simple oil from water separator system which provides consistent levels of separation of oil from water over a predetermined range of inflow conditions.

BRIEF DESCRIPTION OF INVENTION

Accordingly, in one broad form of the invention there is provided an oil from water separator including an oil disengagement chamber adapted to receive an oil and water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water

mixture floating on the surface thereof; said oil disengagement chamber partially separated from an effluent water chamber by an under flow baffle which ducts said substantially oil free volume of water to said effluent water chamber; said oil from water separator characterised in that outflow of said substantially oil free volume of water from said effluent water chamber is limited by flow retarding means to a rate of outflow which is a function of the head of the liquid in said effluent water chamber.

In a further broad form of the invention there is provided an oil from water separator including an oil disengagement chamber adapted to receive an oil and water mixture and retain it for an extended time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof; characterised in that outflow from said chamber is controlled in a predetermined way by flow retarding means.

In a further broad form of the invention there is provided an oil from water separation system including an oil disengagement chamber having a flush storage volume defined between a chamber high liquid level and a chamber low liquid level; a liquid volume equivalent to said flush storage volume caused to exit from said chamber on attainment of said chamber high liquid level.

Preferably said flush storage volume is caused to exit by means of a siphon mechanism.

In a further broad form of the invention there is provided an oil from water separator including an oil disengagement chamber adapted to receive an oil/water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof; characterised in that outflow from said chamber is prevented until said mixture reaches a predetermined chamber high liquid level whereupon said volume of water is caused to exit said chamber.

In a further broad form of the invention there is provided an oil from water separator including an oil disengagement chamber adapted to receive an oil/water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof; characterised in that outflow from said chamber is limited by flow retarding means to a predetermined function of the level of said oil and water mixture in said chamber.

Preferably said flow retarding means is operable only between a chamber low liquid level and a chamber high liquid level.

In one particular preferred form said flow retarding means comprises at least one siphon which primes at said chamber high liquid level and loses prime at said chamber low liquid level.

In an alternative preferred form said flow retarding means comprises at least one bleed aperture or weep hole.

Preferably said at least one bleed aperture or weep hole is located at the level of said chamber low liquid level.

More preferably said at least one bleed aperture or weep hole is sized with reference to expected inflow of said oil and water mixture into said oil disengagement chamber such that, during operation, the level of said oil and water mixture will rise from said chamber low liquid level up to a higher liquid level and then return to said chamber low liquid level, thereby defining for each situation an oil and water mixture active lag capacity or accumulation capacity between said chamber low liquid level and said higher liquid level.

More preferably said active lag capacity or accumulation capacity has a characteristic which is a function of

(a) inflow rate

(b) desired residence time of said oil and water mixture in said oil disengagement chamber.

BRIEF DESCRIPTIONS OF THE DRAWINGS

Embodiments of the invention will now be described with reference to the accompanying drawings wherein: -

Fig 1 illustrates a Prior Art (API) separator and

Fig 2 illustrates a separator system according to a first embodiment of the system.

Fig. 3 illustrates the sequence of filling and emptying of the separator system of Fig. 2.

Fig.4A is a graph of head versus flow for the separator system of Fig. 2,

Fig. 4B illustrates in cross section the first embodiment system of Fig 2 to which Fig 4A is applicable.

Fig. 5A is a graph of head versus flow for the system, of Fig. 5B,

Fig. 5B illustrates in cross section a separator system according to a second embodiment of the invention,

Fig. 6A is a graph of head versus flow for the system of Fig 6B,

Fig. 6B illustrates, in cross section, a separator system according to a third embodiment of the invention involving multiple weep holes,

Fig. 7 is a graph of the behaviour of water level in the system of Fig. 2 in the form of a graph of water level versus time,

Fig. 8 illustrates the behaviour of the system of Fig. 2 under alternative operating conditions in the form of a graph of water level versus time,

Fig. 9 illustrates the behaviour of the system of Fig. 5 in the form of a graph of water level versus time,

Fig. 10 illustrates particular flow characteristics of particular implementations of the invention (example 2) and

Fig. 11 is a top view and side section view of a separator system according to a further embodiment of the invention.

Fig. 12 is a side section view of multiple separator systems connected in a flow-through, series configuration.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The Prior Art separator 10 of Fig 1 comprises an entry chamber 11 separated by a baffle 12 from an oil disengagement chamber 13 which, in turn, is separated from an effluent water chamber (15) by a baffle (14).

Various embodiments of the invention as to be described below are characterised in their most broad form by the addition of a flow retarding device to an outlet portion of a separator. The separator can be in the box form of the prior art API separator of Fig. 1 or can take an alternative form (for example refer the cylinder form of example 3 of Fig. 11 to be described later in this specification).

The flow retarding device acts to ensure that for the majority of operating conditions likely to be encountered,

water in the storage volume will have a sufficient residence time and flow in a sufficiently undisturbed manner to ensure oil from water separation substantially to a predetermined value.

In the embodiments described below the flow retarding device operates continuously to retard flow. Embodiments differ in how the outflow is permitted.

In all cases, accumulation occurs in the oil disengagement chamber as a result of control of outflow.

Furthermore, it imposes an outflow rate from the separator which is a function of the liquid head over the outflow level in the separator.

FIRST EMBODIMENT

With reference to Fig 2 an oil from water separator system 20 according to a first embodiment of the invention is illustrated.

Fig. 3 shows a series of operating conditions A - E for the separator of Fig. 2.

The system 20 directs an influent of oily water through or under a baffle 12 to an oil disengagement chamber 21 the water from which passes beneath a skimmer wall or second baffle 14 to a siphon pipe 22 in an end wall 16. This siphon pipe discharges effluent water into exit pipe 25 through draw off chamber 23.

The siphon pipe 22, in operation, causes the level of liquid in oil disengagement chamber 21 to move between high level 27 and low level 28.

The volume of liquid defined between these two levels forms an accumulation capacity which is designated the flush storage volume or oil and water accumulation volume 29.

In use water laden with oil enters oil disengagement chamber 21 as in Fig 3 with the level in the chamber 21 rising until the maximum accumulation volume 29 is achieved at which time siphon pipe 22 operates to cause the flush storage volume or accumulation volume 29 to exit via exit pipe 25 until the siphon breaks at low level 28. Low level 28 is selected to be, for design conditions, such that accumulated, separated oil cannot pass under the baffle 14 and escape from the separator oil disengagement chamber.

As more oil laden water enters oil disengagement chamber 21 the process repeats itself in accordance with Fig 3 C, D, E.

In this manner a relatively large volume of oil/water mixture is retained for a relatively long period of time to allow oil separation to occur prior to siphoned exit.

Restated in other terms: A feature of this embodiment is the incorporation of one or more automatic siphons which release water only periodically from an oil disengagement chamber and which chamber creates a potential storage for a selected volume of first flush oil/water mixture or a major

oil spillage of a volume equal to the flush storage volume or accumulation volume 29.

This volume 29 is sized to contain a major oil spillage or to be filled progressively with oil/water mixture from successive rainfall events. Until this volume 29 is accumulated, oil globules can coalesce and separate from the water over a period greater than the residence time available in the standard flow through decant separator of Fig. 1 for a given separator tank volume. The oil disengagement chamber 21 is quiescent with virtually zero turbulence except at the end of each cycle when the siphon is operating.

When the water surface reaches a selected chamber high liquid level 27 a siphon which discharges into draw off chamber 23 is primed whereby substantially oil-free water is released until the water surface falls to a selected chamber low liquid level 28 at which the siphon breaks. This releases a volume of effluent water equal to the accumulation volume 29 leaving capacity for the next cycle of oil/water inflows.

One can more specifically differentiate the volumes of liquid in the separator and, more specifically in the oil disengagement chamber as follows:

A. The flush storage volume or oil and water accumulation volume 29 as previously defined comprising that volume of liquid which can be accumulated in the disengagement chamber 21 between low level 28 and high level 27.

B. A separated oil volume 24 defined as the volume of liquid which can be stored in the chamber 21 between low level 28 and the lower edge 17 of baffle 14 defined at under pass level 18 in Fig. 2.

C. A quiescent volume 19 defined between under pass level 18 and the bottom of the disengagement chamber 21.

As will be appreciated the quiescent volume 19 will, in use, always contain a liquid. In a correctly sized and designed separator this liquid will be substantially effluent water.

As will be further appreciated periodic flushing of the separator by operation of the flow retarding device 26 will result in a volume of liquid equal to the oil and water accumulation volume 29 being moved from the oil disengagement chamber 21 through the effluent water chamber 85 and, via the flow retarding device 26 to the draw off chamber 23 and exit pipe 25. The liquid actually moved will include liquid found in all of the defined volumes 19, 24, 29, but not all of it in any one instance.

It is the oil and water accumulation volume 29 with its dynamic nature in that separation can take place within this volume whilst the liquid actually contained within the volume changes in quantity over time which provides the substantive separation characteristic and permits effective residence times of the order of hours (thereby achieving effective oil/water separation) for a treatment capacity in a given

separator size greater than can be achieved with an equivalent sized API-type separator.

It will be further observed that when outflow does occur the rate of outflow is a function of the head of the liquid in the effluent water chamber 85.

Fig. 4A illustrates a head versus flow characteristic for the siphon arrangement of the first embodiment of Fig. 2.

Fig.4B is a side section view of the siphon-based retarding device 26 of Fig. 2.

SECOND EMBODIMENT

Fig. 5A illustrates a second embodiment of the invention (in cross section) comprising a flow retarding device 30 in the end wall of a storage volume 31. In this instance the flow retarding device 30 comprises a retention wall 32 having a bleed aperture 33 (also termed a weep hole) therewithin which will permit the gradual release of liquid in storage volume 31 above a predetermined low level 34. The head versus flow characteristics for this arrangement are shown in Fig. 5B.

THIRD EMBODIMENT

An alternative arrangement of the system of the invention according to a third embodiment is illustrated in cross section in Fig. 6A and comprises, in this instance, a retention wall 42 in an end wall of storage volume 41 having within it a first bleed aperture 43, a second bleed aperture

44 and a third bleed aperture 45 located at respective predetermined levels 46, 47, 48.

Fig. 6A shows a graph of head versus flow for this multiple weep hole embodiment of the flow retarding device 40.

Broadly it will be observed that the first embodiment of Fig. 2 utilises a siphon to achieve controlled flow retardation whilst the second and third embodiments utilise weep holes.

Whereas water will not start to flow through a siphon until a priming level is reached and will continue to flow until the water surface reaches some lower level, water will flow through a hole whenever the hole is submerged on and only on the upstream side.

The objective of controlling the release of water from an oil from water separator is to provide residence time in the separator during which the desired separation of oil droplets from the water can occur.

The siphon achieves this residence time by storing incoming water until the provided capacity is full, when the relatively oil-free water is released and the cycle starts again.

In some applications of a disengagement chamber for oil from water separation, the load may be regular as in daily washdowns and in these applications a slow drawdown overnight may be more desirable than the siphon characteristic.

Such an alternative characteristic can be achieved by replacing the siphon with weep holes, varying their number, sizes and locations to achieve any desired outflow/level relationship. This allows the water surface in the separator to return slowly to the bottom operating level without first reaching some top operating level but after a sufficient time for oil from water separation.

The relationship between separator water level and outflow for a siphon and one or more weep holes is illustrated in Figures 4A, 5A and 6A as earlier described.

Relative Inflow - Outflow Behaviour

The movement in separator water level during an inflow event, however, will be broadly similar for the siphon and the weep holes, at least as far as achieved residence time is concerned. With some generality it can be asserted that:

- An effective separator design will not require a cycle time (from rising above the bottom operating level to returning to it) of more than 12-24 hours
- For rainfall runoff typical of a 1 in 1 year event, the separator can fill to the top operating level in less than an hour
- The initial rise of the separator water level will be steep compared with the exponential fall after the outflow through the weep holes or the siphon (see Figures 7, 8 and 9)

- The earlier release of water through a weep hole than will occur with a siphon not yet at its priming level will have negligible effect on the initial rise in water level
- During water level fall from the top operating level, the flow through both the weep hole and the siphon will decline exponentially as a function of head above the outlet
- If the inflow event is not large enough to prime the siphon, the water will remain in the separator until there is sufficient water; with a weep hole, the water outflow will continue to decline exponentially until the weep hole level is reached, still providing (by design) the desired residence time.

FOURTH EMBODIMENT

Fig. 11 illustrates an alternative storage volume arrangement which, as seen in plan view, takes the form of a doughnut-shaped tank 50 with inflow to a central distributor in the form of a stand pipe 51.

Outflow is from a circular retention wall 52. Controlled outflow is achieved either via a siphon pipe 53 to clarified water outlet 54 or via bleed apertures (not shown) in retention wall 52 or other flow retarding means.

For this embodiment dimensions of the siphon pipe and/or the bleed apertures can be as for either example 1 or example 2 below.

Active Lag Capacity

With reference to Figs. 7, 8 and 9 the previously described embodiments can be seen to incorporate an active lag capacity or accumulation volume 60 which operates above a predefined liquid low level 61 and can extend as high as a predefined liquid high level 62 set by an overflow weir (such as weir 87 in Fig. 2).

The active lag capacity 60 comes into operation when inflow to the oil disengagement chamber is such that the liquid level rises above liquid low level 61.

Liquid low level 61 has associated with it, in these examples, either the lower end of a siphon or the lowest of at least one weep hole sized in the manner previously described and which, in combination with the end wall 16 or retention walls 32, 42, 52, forms a flow retarding means which is the dominant factor which controls the shape and characteristic of the active lag capacity 60 for a given inflow characteristic and storage volume characteristic.

The active lag capacity 60 by virtue of its coming into existence whilst there is mismatched relative inflow and outflow from the oil disengagement chamber has a dynamic or active characteristic which assists in efficient oil from water separation such that, for a predefined range of inflows, outflow will contain a proportion of oil in water substantially below a predefined limit.

Interconnected Separator Units

With reference to Fig. 12 three separator units are connected in series whereby a first separator 81 having a lag capacity in the form of a first active lag volume 91 feeds its output, as illustrated, directly into second separator unit 82 having a second active lag volume 92, which separator unit in turn feeds its outflow into third separator unit 83 having a third active volume 93. In this instance the active lag capacity of the total system is determined by the composite characteristic of the active lag volumes 91, 92, 93.

This arrangement has particular advantage where site shape and/or size dictates that one large tank is inappropriate. The arrangement also provides additional flexibility in terms of total residence time.

It has one particular distinguishing characteristic as compared with the single tank implementations in that overflow from first separator 81 in the event of unforseen catastrophic inflow merely results in overflow of untreated or insufficiently treated oil/water mix into second volume 92 of second separator 82 rather than the immediate discharge of untreated or insufficiently treated oil/water mixture from the entire treatment system. This multiple tank arrangement, therefore, provides a "soft-fail" mode as well as providing additional design flexibility.

Examples of the various embodiments will now be given:

EXAMPLE 1

An API type rectangular tank with siphon installed in the exit wall. Typical dimensions are 7m long, 1.5m wide and siphon operating levels 1.6m and 0.8m above the floor. Volume = approx 17KL, about half of which is the range between siphon operating levels. The siphon is made of 18mm OD hard drawn copper pipe and takes about 10 hours to draw the water level down.

EXAMPLE 2

Fig. 10 illustrates a particular example of head versus flow behaviour for the siphon embodiment of Fig. 2, the single weep hole embodiment of Fig. 5 and the multiple weep hole embodiment of Fig. 6 for various hole diameters as indicated.

The above describes only some embodiments of the present invention and modifications obvious to those skilled in the art can be made thereto without departing from the scope and spirit of the present invention.

It is expected that, in many embodiments, operation of the oil from water separator system would be unattended and/or automatic.

INDUSTRIAL APPLICABILITY

The oil from water separator device can be applied in situations such as transformer substations and other industrial sites where retention and controlled discharge of an oil and water mix to a specified level of separation is required.

CLAIMS

1. An oil from water separator including an oil disengagement chamber adapted to receive an oil and water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof; said oil disengagement chamber partially separated from an effluent water chamber by an under flow baffle which ducts said substantially oil free volume of water to said effluent water chamber; said oil from water separator characterised in that outflow of said substantially oil free volume of water from said effluent water chamber is limited by flow retarding means to a rate of outflow which is a function of the head of the liquid in said effluent water chamber.

2. The separator of claim 1 wherein said flow retarding means is operable to accumulate said oil and water mixture in said oil disengagement chamber in an accumulation volume above a chamber low liquid level.

3. The separator of claim 1 or claim 2 wherein said flow retarding means comprises at least one siphon which primes at a chamber high liquid level and loses prime at said chamber low liquid level.

4. The separator of claim 1 or claim 2 wherein said flow retarding means comprises at least one bleed aperture or weep hole.

5. The separator of claim 4 wherein said at least one bleed aperture or weep hole is located at the level of said chamber low liquid level.

6. The separator of claim 1 wherein said flow retarding means is sized with reference to expected inflow of said oil and water mixture into said oil disengagement chamber such that, during operation, the level of said oil and water mixture will rise from said chamber low liquid level and then return to said chamber low liquid level, thereby defining an oil and water mixture accumulation volume above said chamber low liquid level.

7. The separator of claim 6 wherein said accumulation volume has a characteristic which is a function of

(a) inflow rate and

(b) desired residence time of said oil and water mixture in said oil disengagement chamber.

8. An oil from water separation system including an oil disengagement chamber having a flush storage volume defined between a chamber high liquid level and a chamber low liquid level; said flush storage volume caused to exit from said chamber on attainment of said chamber high liquid level.

9. The system of Claim 8 wherein said flush storage volume is caused to exit by means of a siphon mechanism.

10. An oil from water separator including an oil disengagement chamber adapted to receive an oil and water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof; characterised in that outflow from said chamber is prevented until said mixture reaches a predetermined chamber high liquid level whereupon said volume of water is caused to exit said chamber.

11. The separator of Claim 10 wherein, on reaching said chamber high liquid level, outflow is initiated and maintained until a predetermined chamber low liquid level in said chamber is reached at which time outflow is terminated.

12. The separator of Claim 11 wherein said outflow is controlled by means sensitive to said chamber high liquid level and said chamber low liquid level.

13. The separator of any one of Claim 10 wherein said outflow is drawn from a point at said predetermined low level in said mixture.

14. The separator of Claim 12 or Claim 13 wherein said means sensitive to said chamber high liquid level and said chamber low liquid level is a siphon.

15. The separator of Claim 12 or Claim 13 wherein said means sensitive is a level switch actuated pumping system.

16. The separator of claim 10 wherein said flow retarding means operates so that outflow is prevented until said mixture reaches a predetermined chamber high liquid level whereupon said volume of water is caused to exit said chamber.

17. The separator of Claim 10 or Claim 11 wherein, on reaching said chamber high liquid level, outflow is initiated and maintained until a predetermined chamber low liquid level in said chamber is reached at which time outflow is terminated.

18. The separator of Claim 10 or Claim 11 wherein said outflow is controlled by means sensitive to said chamber high liquid level and said chamber low liquid level.

19. The separator of any one of Claims 10-18 wherein said outflow is drawn from a point at said predetermined low level in said mixture.

20. The separator of claim 10 wherein said flow retarding means comprises a retention wall having at least one aperture at a predetermined level passing therethrough; said at least one aperture adapted to regulate flow of water from said disengagement chamber when said mixture is above said predetermined level.

21. An oil from water separator including an oil disengagement chamber adapted to receive an oil and water mixture and retain it for an extended time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of

water having a layer of oil derived from said oil and water mixture floating on the surface thereof; characterised in that outflow from said chamber is controlled in a predetermined way by flow retarding means.

22. An oil from water separator including an oil disengagement chamber adapted to receive an oil/water mixture and retain it for a sufficient time in a relatively undisturbed state whereby oil in the mixture floats to the top of the mixture resulting in a substantially oil free volume of water having a layer of oil derived from said oil and water mixture floating on the surface thereof; characterised in that outflow from said chamber is limited by flow retarding means to a predetermined function of the level of said oil and water mixture in said chamber.

23. The separator of claim 22 wherein said flow retarding means is operable only between a chamber low liquid level and a chamber high liquid level.

24. The separator of claim 23 wherein said flow retarding means comprises at least one siphon which primes at said chamber high liquid level and loses prime at said chamber low liquid level.

25. The separator of claim 22 wherein said flow retarding means comprises at least one bleed aperture or weep hole.

26. The separator of claim 25 wherein said at least one bleed aperture or weep hole is located at the level of said chamber low liquid level.

27. The separator of claim 22 wherein said flow retarding means is sized with reference to expected inflow of said oil and water mixture into said oil disengagement chamber such that, during operation, the level of said oil and water mixture will rise from said chamber low liquid level up to a higher liquid level and then return to said chamber low liquid level, thereby defining for each situation an oil and water mixture active lag capacity or accumulation capacity between said higher liquid level and said chamber high liquid level.

28. The separator of claim 27 wherein said active lag capacity or accumulation capacity has a characteristic which is a function of

(a) inflow rate and

(b) desired residence time of said oil and water mixture in said oil disengagement chamber.

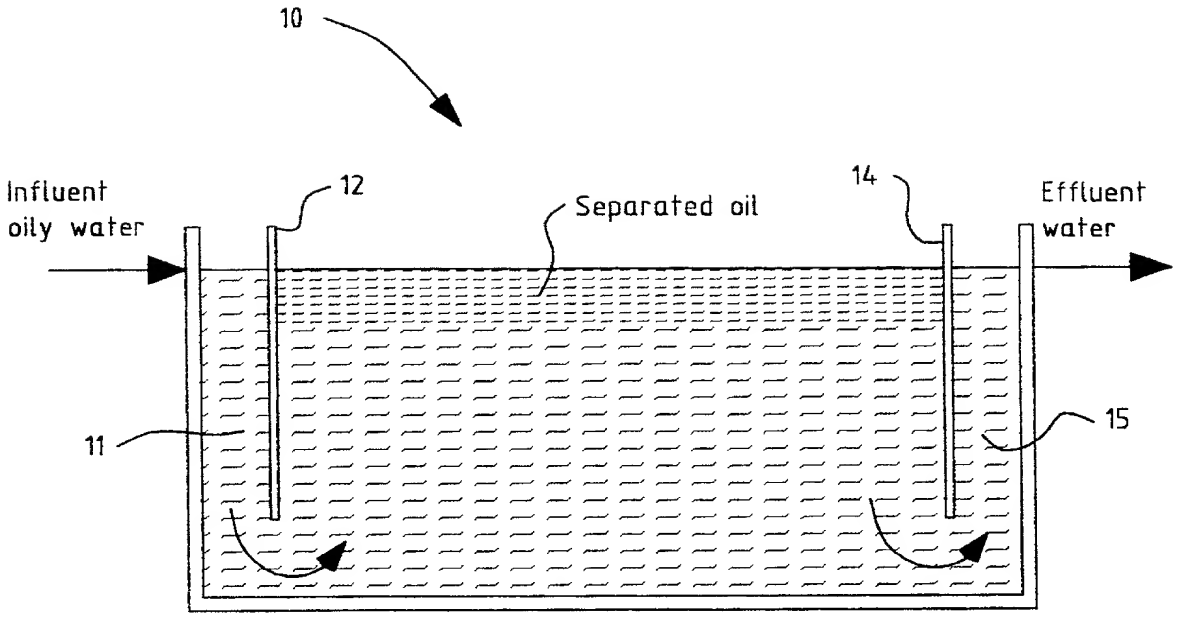
29. A method of conversion of a decant separator to a separator of the type defined by claim 1, said method comprising installing a flow retarding device in or in association with a weir wall of said decant separator whereby rate of outflow of said substantially oil free volume of water is a function of the head of the liquid in said effluent water chamber.

30. A flow retarding device for an oil from water separator of the type defined by claim 1.

31. An oil from water separator system comprising a plurality of oil from water separators of the type defined by claim 1,

said plurality of separators connected in series whereby outflow from a first separator passes to an inlet of our a second separator.

32. The system of claim 31 wherein decant overflow from said first separator passes to said inlet of said second separator.



Prior Art

Fig. 1

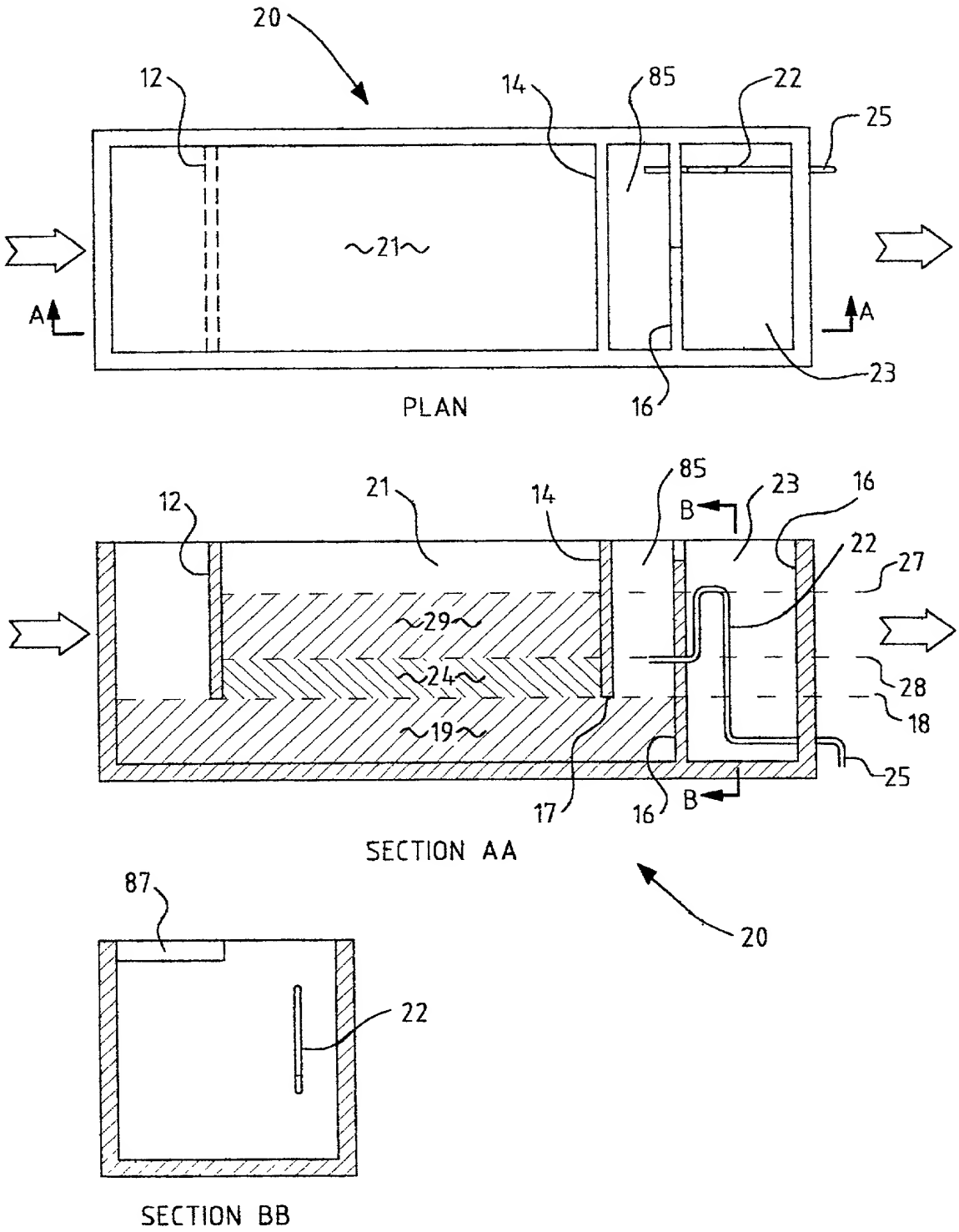

20
12
14
85
22
25
21
A
A
23
16
PLAN
21
14
85
B
23
16
12
22
27
29
24
28
18
19
25
17
16
B
SECTION AA
20
87
22
SECTION BB

Fig. 2

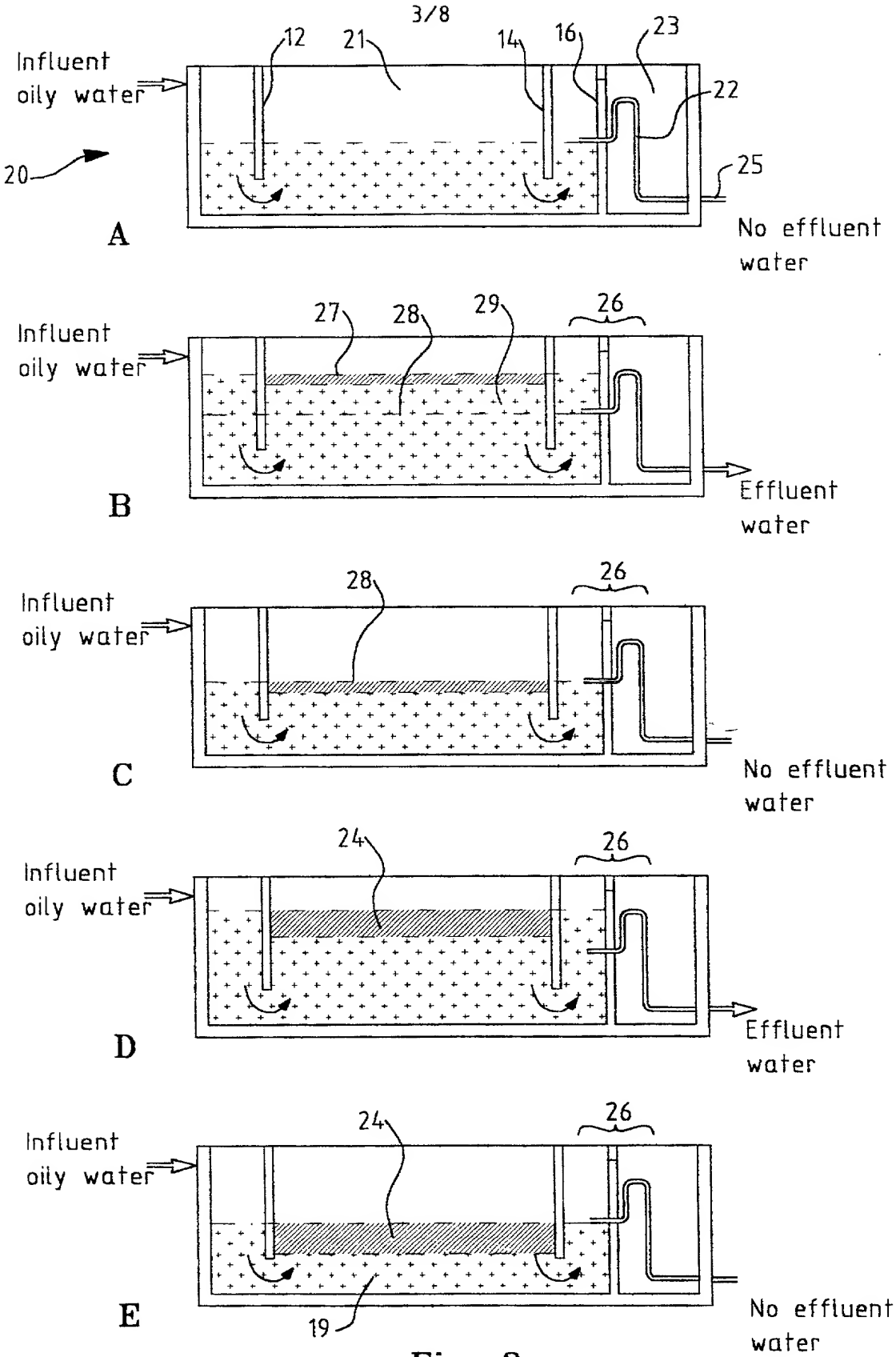

Influent oily water
20
12
21
14
16
23
22
25
A
No effluent water
27
28
29
26
B
Effluent water
C
24
D
E
19

Fig. 3

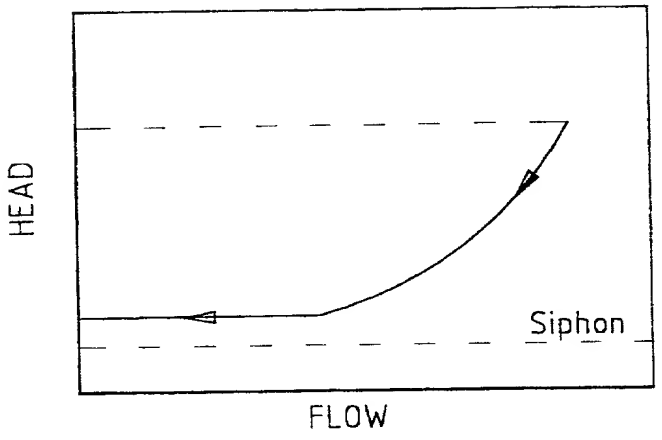


Fig. 4A

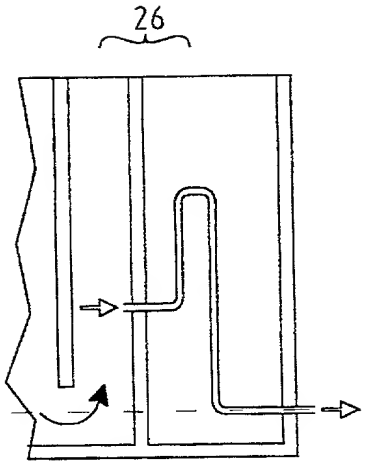


Fig. 4B

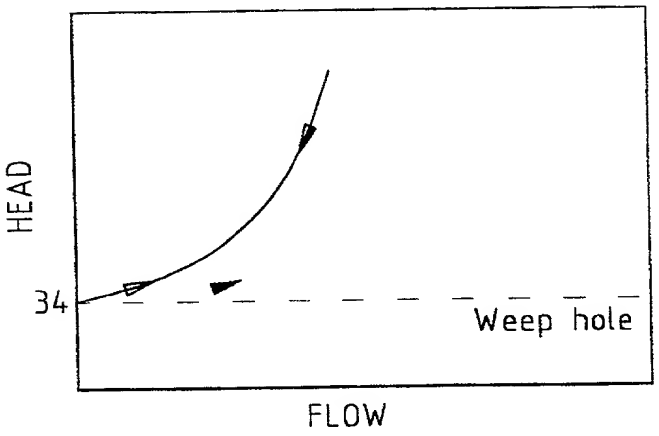


Fig. 5A

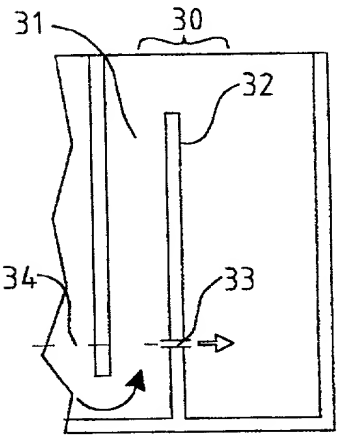


Fig. 5B

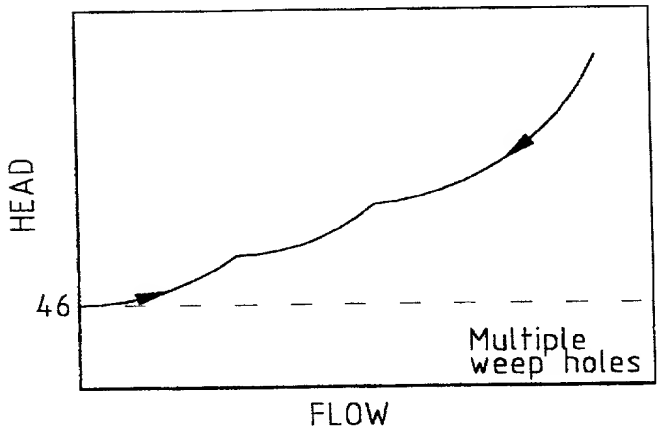


Fig. 6A

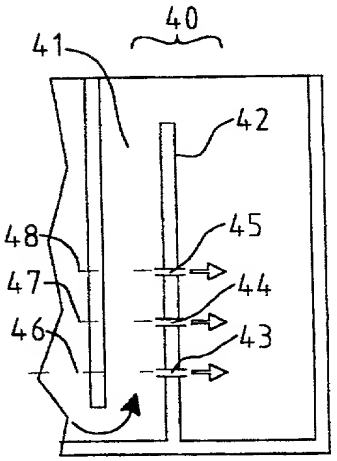


Fig. 6B

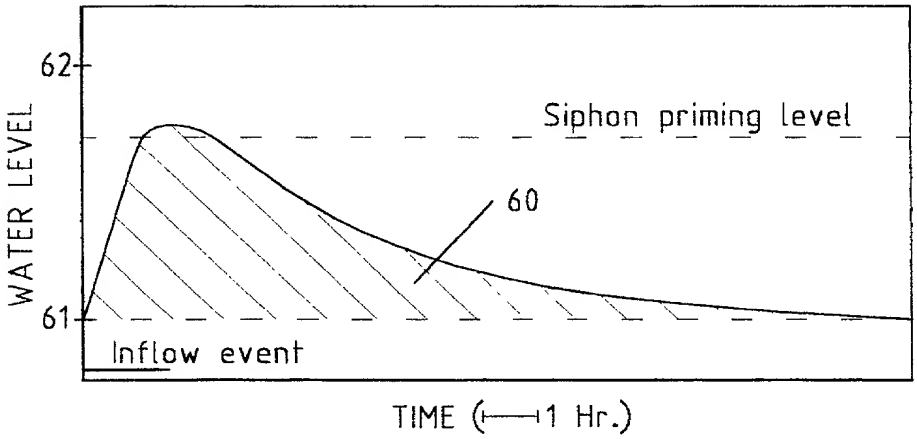


Fig. 7

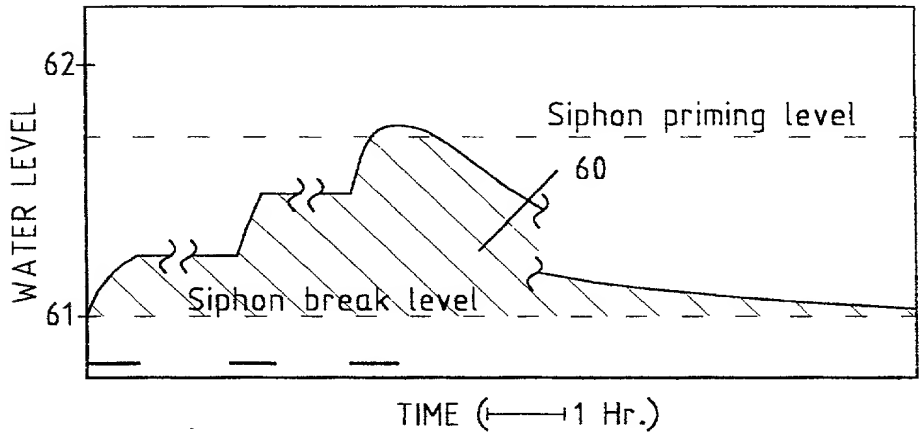


Fig. 8

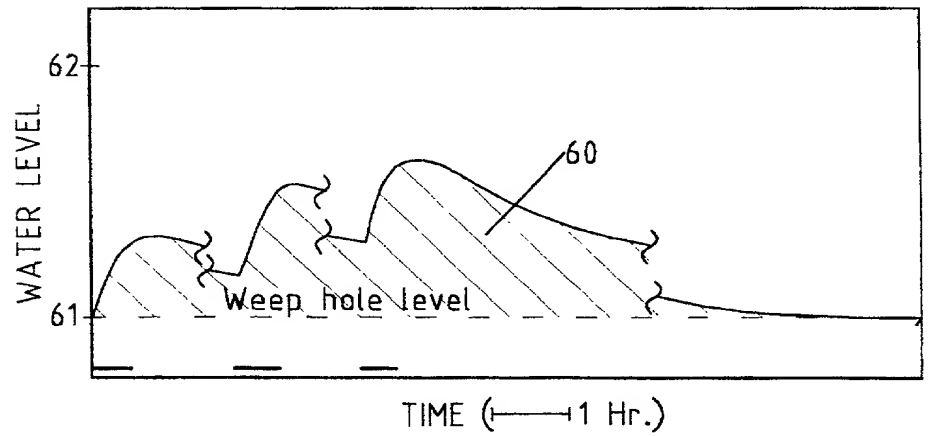


Fig. 9

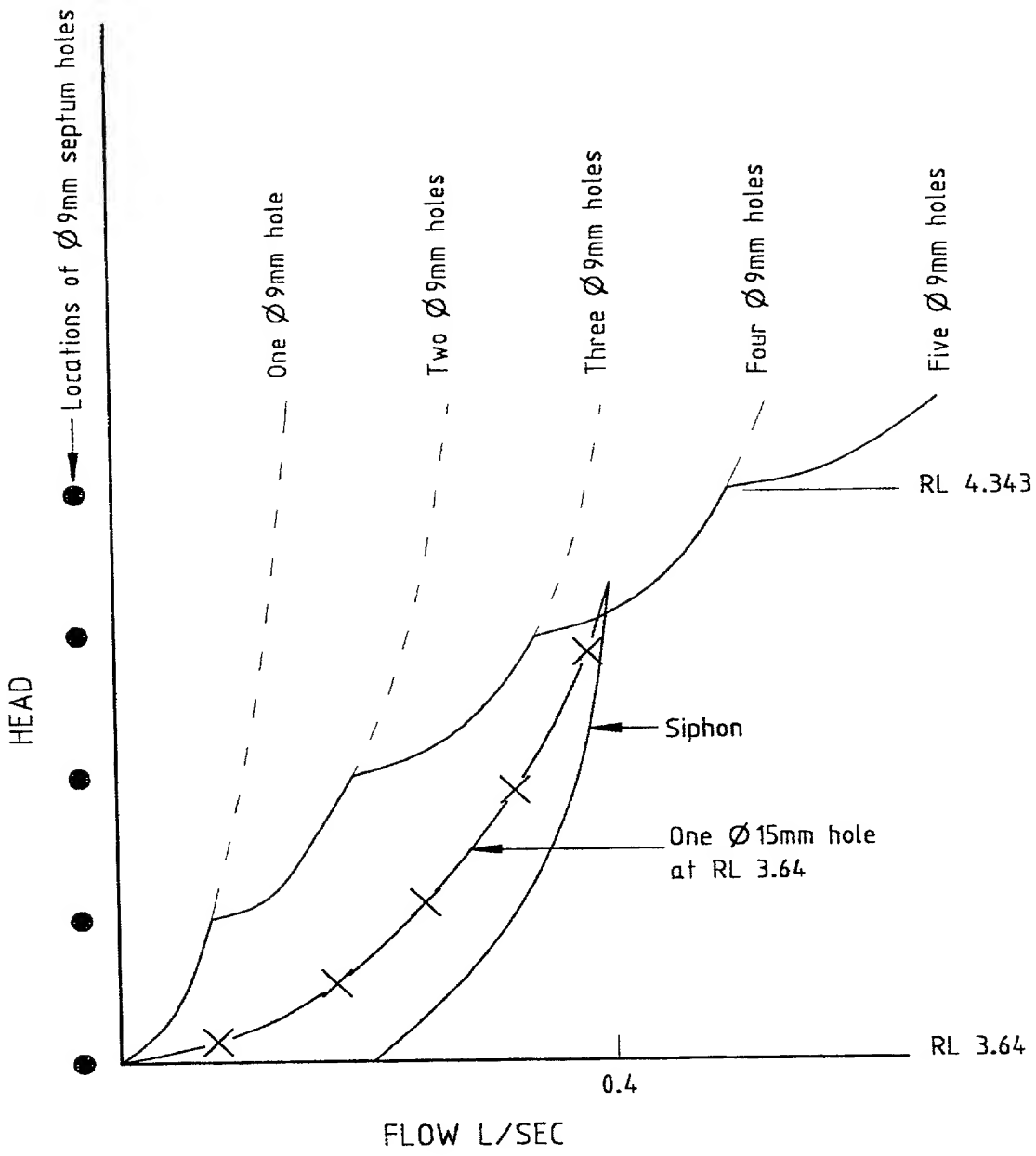

Locations of Ø 9mm septum holes
One Ø 9mm hole
Two Ø 9mm holes
Three Ø 9mm holes
Four Ø 9mm holes
Five Ø 9mm holes
RL 4.343
Siphon
One Ø 15mm hole
at RL 3.64
RL 3.64
HEAD
0.4
FLOW L/SEC

Fig. 10

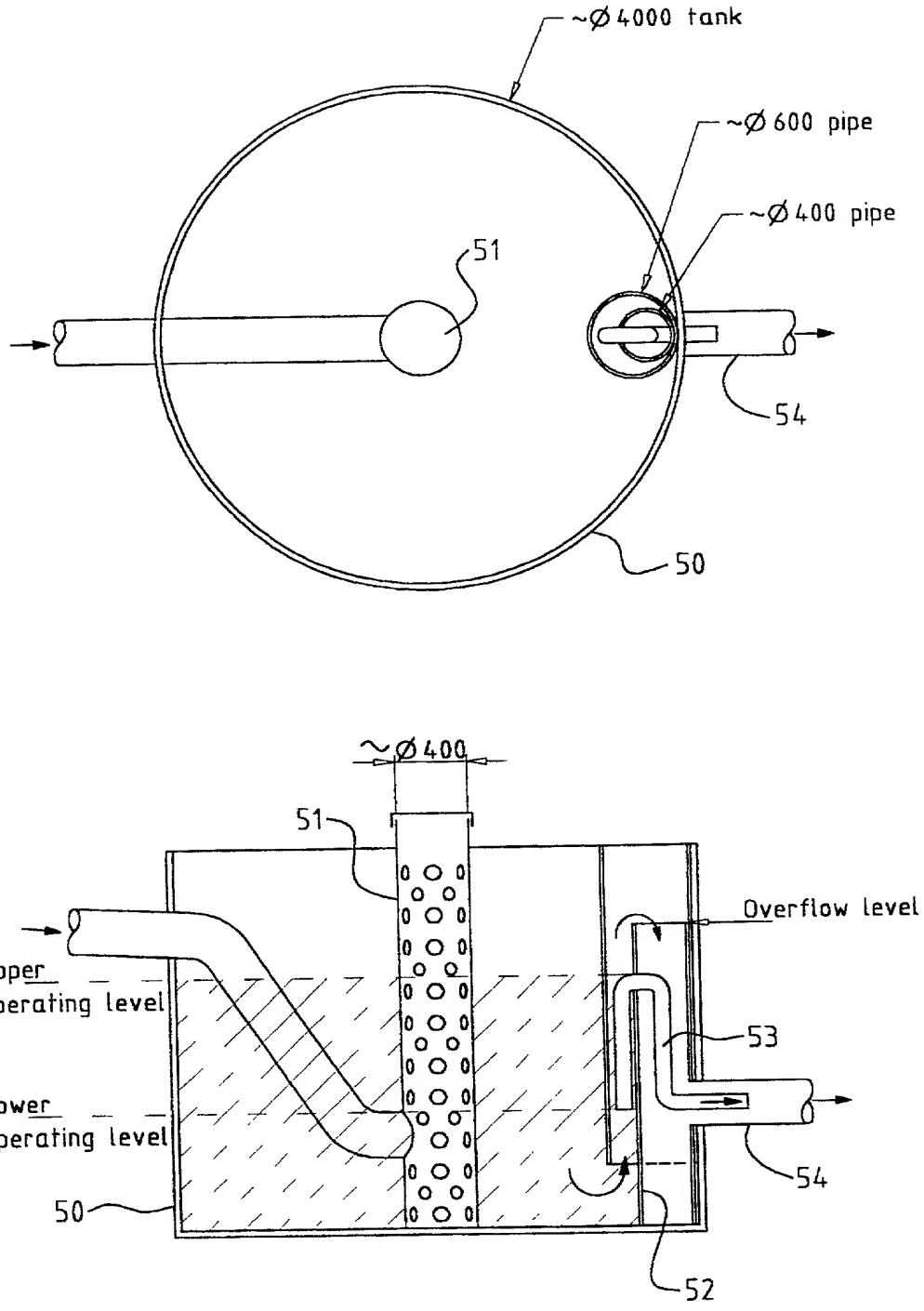


Fig. 11

SUBSTITUTE SHEET (Rule 26)

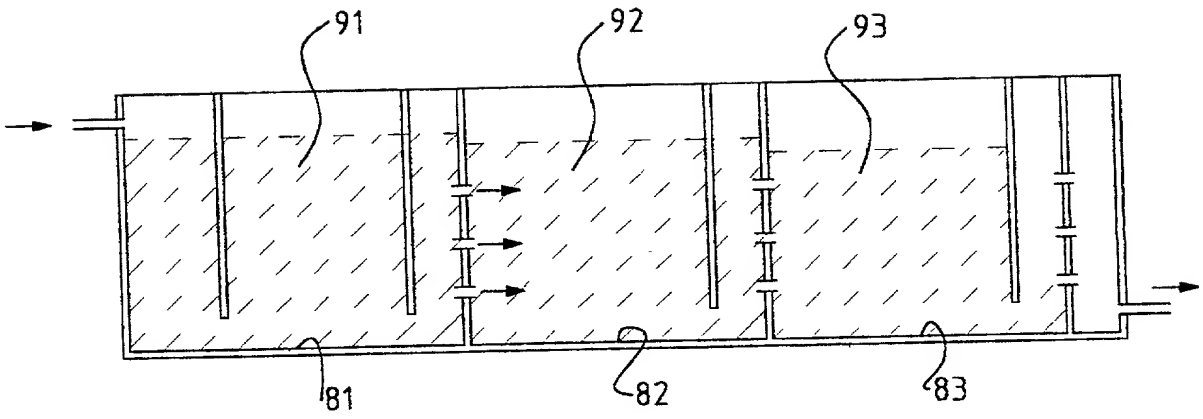


Fig. 12

DECLARATION - USA PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **OIL FROM WATER SEPARATOR** the specification of which:

(a) ☐ is attached hereto; or

(b) ☒ was filed on October 25, 1999 as Application No. 09/403,800; or

(c) ☒ was described and claimed in PCT International Application No. PCT/AU91/00298 filed on April 24, 1998 and as amended under PCT Article 19 on _____ (if any) and/or under PCT Article 34 on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above;

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56;

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent, design or inventor's certificate or any PCT international application(s) listed below and have also identified below any foreign application(s) for patent, design or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed for the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 U.S.C. § 119
AUSTRALIA	PO 6393	April 24, 1997	☒ YES NO ☐
AUSTRALIA	PP2742	April 1, 1998	☒ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below, and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

524 Rec'd PCT/PTO 25 OCT 1999.

U.S. Application No.	International Application No.	Attorney Docket No.
Unknown	PCT/AU98/00298	DUMMER9.001APC

09/403800

Date: October 25, 1999

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 USC 371

International Application No.:	PCT/AU98/00298
International Filing Date:	April 24, 1998
Priority Date Claimed:	April 24, 1997
Title of Invention:	OIL FROM WATER SEPARATOR
Applicant(s) for DO/EO/US:	David Bleasdale Tolmie and Phineas Balantyne Stone

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. (X) This is a **FIRST** submission of items concerning a filing under 35 USC 371.

2. () This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 USC 371.

3. (X) This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).

4. (X) A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. (X) A copy of the International Application as filed (35 USC 371(c)(2))

   a) (X) is transmitted herewith (required only if not transmitted by the International Bureau).
   b) (X) has been transmitted by the International Bureau.
   c) () is not required, as the application was filed in the United States Receiving Office (RO/US).

6. () A translation of the International Application into English (35 USC 371(c)(2)).

7. (X) Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3))

   a) () are transmitted herewith (required only if not transmitted by the International Bureau).
   b) () have been transmitted by the International Bureau.
   c) () have not been made; however, the time limit for making such amendments has NOT expired.
   d) (X) have not been made and will not be made.

8. () A translation of the amendments to the claims under PCT Article 19 (35 USC 371(c)(3)).

9. () An oath or declaration of the inventor(s) (35 USC 371(c)(4)).

10. (X) A copy of the International Preliminary Examination Report with any annexes thereto, such as any amendments made under PCT Article 34.

11. () A translation of the annexes, such as any amendments made under PCT Article 34, to the International Preliminary Examination Report under PCT Article 36 (35 USC 371(c)(5)).

KNOBBE, MARTENS, OLSON & BEAR, LLP
620 NEWPORT CENTER DR 16TH FLOOR NEWPORT BEACH, CA 92660
(949) 760-0404 FAX (949) 760-9502

Items 11. to 16. below concern other document(s) or information included:

12.	()	An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
13.	()	An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
14.	(X)	A FIRST preliminary amendment.
	()	A SECOND or SUBSEQUENT preliminary amendment.
15.	()	A substitute specification.
16.	()	A power of attorney and/or address letter.
17.	(X)	International Application as published. (Cover Sheet only).
18.	()	Small Entity Statement.
19.	()	PCT Form PCT/IPEA/402.
20.	()	PCT Form PCT/IB/308.
21.	()	PCT request form.
22.	(X)	PCT International Search Report.
23.	(X)	A return prepaid postcard.
24.	(X)	The following fees are submitted:

				FEES
	BASIC FEE			$970
CLAIMS	**NUMBER FILED**	**NUMBER EXTRA**	**RATE**	
Total Claims	30 - 20 =	10 ×	$18	$180
Independent Claims	6 - 3 =	3 ×	$78	$234
Multiple dependent claims(s) (if applicable)			$260	$-0-
	TOTAL OF ABOVE CALCULATIONS		$1384	
Reduction by 1/2 for filing by small entity (if applicable). Verified Small Entity statement must also be filed. (NOTE 37 CFR 1.9, 1.27, 1.28)			$	
	TOTAL NATIONAL FEE			$ 1384.00
	TOTAL FEES ENCLOSED			$ 1384.00
		amount to be refunded:		$
		amount to be charged:		$

25. (X) The fee for later submission of the signed oath or declaration set forth in 37 CFR 1.492(e) will be paid upon submission of the declaration.

26. () A check in the amount of $1384.00 to cover the above fees is enclosed.

27. () Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40 per property.

28. (X) The Commissioner is hereby authorized to charge only those additional fees which may be required to avoid abandonment of the application, or credit any overpayment to Deposit Account No. 11-1410. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

KNOBBE, MARTENS, OLSON & BEAR, LLP
620 Newport Center Drive
Sixteenth Floor
Newport Beach, CA 92660

Lowell Anderson
Signature

Lowell Anderson
Printed Name

30,990
Registration Number

H:\LOA-2992.DOC: clk
102299

ESTABLISHMENT OF RIGHT OF ASSIGNEE TO TAKE ACTION
AND
REVOCATION AND POWER OF ATTORNEY

To the Commissioner of Patents and Trademarks:

The undersigned is empowered to act on behalf of the assignee indicated below (the "Assignee"). The original assignment of the application filed on October 25, 1999 as Application No. 09/403,800 and as described and claimed in PCT International Application No. PCT/AU91/00298 filed on April 24, 1998, for the invention in **OIL FROM WATER SEPARATOR** from the inventors to the Assignee is being submitted herewith for recordation by the Assignment Branch. A true copy of this Assignment is attached hereto. This Assignment represents the entire chain of title of this invention from the Inventor(s) to the Assignee. I have reviewed this Assignment, and to the best of the Assignee's knowledge and belief, the Assignee is the owner of the entire right, title, and interest in the above-referenced application.

I declare that all statements made herein of my own knowledge are true, and that all statements made upon information and belief are believed to be true, and further, that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001, and that willful, false statements may jeopardize the validity of the application, or any patent issuing thereon.

The undersigned hereby revokes any previous powers of attorney in the subject application, and hereby appoints the registrants of Knobbe, Martens, Olson & Bear, LLP, 620 Newport Center Drive, Sixteenth Floor, Newport Beach, California 92660, Telephone (949) 760-0404, **Customer No. 20,995**, as its attorneys with full power of substitution and revocation to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected herewith. This appointment is to be to the exclusion of the inventor(s) and his attorney(s) in accordance with the provisions of 37 C.F.R. § 3.71.

Please use **Customer No. 20,995** for all communications.

Assignee: Unisearch Limited

By: W. Peirson

Printed Name: W. L. PEIRSON

Title: MANAGER

Address: 221-227 Anzac Parade
Kensington, NSW 2033
Australia

Dated: 14 December 1999

H:\LOA-3220.DOC: clk
111799

Prior U.S.A. Application(s)

Application No.: _____ Filing Date: _____ Status: _____

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful, false statements may jeopardize the validity of the application or any patent issued thereon.

1-00 Full name of first inventor: David Bleasdale Tolmie

Inventor's signature _____ Dated: 14/12/99

Residence (city and country): 106 Moncrieff Drive, East Ryde NSW 2113, AUSTRALIA AUX

Citizenship: Australian

Post Office Address: Same as above.

2-00 Full name of second inventor: Phineas Balantyne Stone

Inventor's signature _____ Dated: 7-12-1999

Residence (city and country): 2 Seddon Hill Road, Harbord NSW 2096, Australia AUX

Citizenship: Australian

Post Office Address: Same as above.

Send Correspondence To:
KNOBBE, MARTENS, OLSON & BEAR, LLP
Customer No. 20,995

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